COLORADO RIVER RECOVERY PROGRAM Project No.:143
FY-2005-2006 PROPOSED SCOPE OF WORK for:

Yampa pike sources

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Category:	Expected Funding Source:
x Ongoing project	x Annual funds
__ Ongoing-revised project	__ Capital funds
__ Requested new project	x Other (explain)
__ Unsolicited proposal	

I. Title of Proposal: **Use of otolith microchemistry to identify habitat sources of pike young-of-year in the Yampa River.**

II. Relationship to RIPRAP:

Green River Action Plan: Yampa and Little Snake rivers

III. Reduce negative impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).

III.A.1. Implement Yampa Basin aquatic wildlife management plan in reaches of the Yampa River occupied by endangered fishes. Each control activity will be evaluated for effectiveness and then continued as needed.

III.A.1.b. Control northern pike.

III. Study Background/Rationale and Hypotheses:

The first stocking of pike on a reservoir with direct flow into the Yampa was in Elkhead Reservoir in the mid 1970’s. There were reports of escaped fish from Elkhead Reservoir as early as 1979 (Tyus and Beard 1990). There is no documented stocking of pike into either Stagecoach Reservoir or Lake Catamount. It is believed pike were in the river system before the reservoirs were built and that after the reservoirs were filled the pike population increased dramatically.

The Yampa River is home to the Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*), which are currently listed as federally endangered species. The section of the Yampa River downstream of Craig, Colorado (river mile 139) has been identified as critical habitat for threatened and endangered fish and northern pike (*Esox lucius*), as well as other nonnative predators, have been identified as major predatory threats to native fish (Nesler 1995).

Hill (2004) studied the suitability of spawning habitat in backwaters along the river, including large off-channel ponds. He speculated that spawning habitat was not sufficient to sustain pike due to high variation in flows, especially through nursery areas. During his study, pike tagged during May 2003 as part of another study were captured in the spillway below Catamount in June 2003. Since Catamount Dam is the last dam on the river system before native fish critical spawning habitat, it is a potential source and control point for pike into the Yampa River system. Hill (2004) indicated reservoirs and off-channel ponds may be contributing more age-0 pike than riverine backwater areas and that future research to control pike recruitment should focus on these areas.

A recent development in fishery science is the use of elemental and isotopic concentrations of calcified structures as chemical fingerprints or natural tags. These chemical fingerprints can potentially be used to discriminate between fish that have inhabited different water bodies, such as nursery areas (Gillanders and Kingsford 2000) and different stocks (Edmonds et al. 1999) and can therefore help estimate the source and migration patterns of individuals.

The most widely used calcified structure for stock discrimination and movement studies are otoliths, which are suspended in endolymph fluid within the inner ear (Campana 1999). Formation of new otolith material occurs when calcium carbonate ($CaCO_3$) crystallizes out of the endolymph fluid onto the outer surface of the otolith. The growth of the otolith corresponds to daily, seasonal, and annual increments (Campana and Neilson 1985). Since the rings are metabolically inert, information recovered at different locations within the otolith can be used to reconstruct events throughout the lifetime of a fish. Changes in the elemental composition across the length of an otolith reflect either changes in the water conditions, or modifications due to the physiological conditions of a fish at a specific time (Kalish 1989; Kennedy et al., 2000).

To effectively manage pike to enhance native fish communities, it is necessary to understand the recruitment patterns and sources of pike. Catamount reservoir is an ideal area to potentially reduce pike numbers. However, before any control measures can be suggested it is critical to understand the source of pike in Catamount. If recruitment from upstream is high, then control measures instituted in Catamount might not be successful; however, if recruitment from upstream is low then it may be possible to reduce pike abundance in the lake. We propose to use otolith microchemistry to estimate recruitment sources within Catamount Reservoir.

In much the same way, to effectively manage for the recovery of native fishes in the Yampa River, a better understanding of sources of recruitment of nonnative fishes is required. This will allow recommendations to be made that will focus on areas with the highest recruitment. We also propose to use otolith microchemistry to estimate pike recruitment sources within the Yampa River.

Another management need is to estimate recruitment in areas below Lake Catamount. Understanding pike recruitment is vital to address management for native species. The information collected for this study could be used as a template for other nonnative fish, such as smallmouth bass, channel catfish, and green sunfish.

IV. Study Goals, Objectives, End Product:

Goal 1. Map degree of movement of pike within the Yampa River system via otolith microchemistry.

Objectives:

- Demonstrate differences in chemical signatures of otoliths of age-0 pike from various sources.
- Evaluate how quickly differences can be detected via laser ablation.
- Estimate the proportion of pike recruited from reservoirs and other spawning areas in the Yampa River.
- Estimate the extent of pike movement from spawning sources and reservoirs to other habitats within the Yampa River system.

Expected Result: Evaluate pike recruitment sources and movements by May 2006

Goal 2. Evaluate trophic relationships of pike within Stagecoach Reservoir, Lake Catamount, Elkhead Reservoir, and portions of the Yampa River using stable isotope analysis.

Objectives:

- Collect adult pike and take dorsal flesh samples at each reservoir and in the Yampa River
- Utilize stable isotope analysis to evaluate diet composition

Expected Result: Estimate proportion of prey types being consumed by pike by May 2006.

V. Study area

The Yampa River is a Colorado River tributary located in northwest Colorado. Initially, we will concentrate on the area from Stagecoach Reservoir to the downstream section of Elkhead Reservoir. The sampling locations will be Stagecoach Reservoir, the river section between Stagecoach Reservoir and Catamount Reservoir, Catamount Reservoir, the river section below Catamount Reservoir, Elkhead Reservoir, backwater areas along these river sections, and off-channel ponds.

VI. Study Methods/Approach

Initially, we will concentrate on the area from Stagecoach Reservoir to the confluence of Elkhead Creek with the Yampa River, including sampling from Elkhead Reservoir (Figure 1). The sampling locations will be Stagecoach Reservoir, the river section between Stagecoach Reservoir and Catamount Reservoir, Catamount Reservoir, the river section below Catamount Reservoir, Elkhead Reservoir, backwater areas along these river sections, and off-channel ponds. This project will focus on the northern pike (*Esox lucius*). Young-of-year pike will be collected via backpack electrofishing and seining (n ~ 200) and adult pike will be collected via trap nets at the entrance to spawning areas (n ~ 100). If trap nets do not produce a sufficient number of pike then angling will be used as a means of capture. Young-of-year (Y.O.Y.) pike will be used for the first two objectives of the study and adult pike will be collected to achieve the third objective.

Experimental design – This will be a three-phase project consisting of two observational experiments (phases 1 and 3) and one manipulative experiment (phase 2). During the first phase Y.O.Y. pike will be collected via electroshocking or seining. Since large differences in numbers of pike produced between a location, site selection will be focused on areas that produced adequate numbers of pike during Hill's (2004) study. We hope to collect thirty pike from each location. The fish will be anesthetized and immediately placed on ice until returned to the lab. At the lab, otoliths will be removed and prepared for microchemistry via protocols being used in other similar studies in Colorado. Standardization of technique will ensure all otolith work within the state can be used for comparative purposes.

During the second phase of the project, a manipulative experiment will be conducted where Y.O.Y will be obtained from a hatchery. The fish will be transported to Lake Catamount where they will be placed in three sentinel cages. Every five days, ten fish will be randomly chosen and removed from each cage and immediately placed on ice. These fish will be returned to the laboratory and have their otoliths removed and prepared for microchemistry.

During the third phase of the project adult pike will be collected from the river. If the flow conditions are suitable, trapnets will be placed at the entrance to spawning areas. If this method does not produce a sufficient number of pike (n ~ 100) then angling will be used as a means of capture. This project seeks to determine how many of the fish in the river have been recruited from the reservoir.

<u>Pilot Study</u>

A pilot study is currently being conducted to determine chemical signatures from specific areas in the Yampa River system. Following protocol set forth in Shiller (2003) water samples were collected from the following 13 sites:

- Yampa River at the inflow of Stagecoach Reservoir
- Center of Stagecoach Reservoir
- Big Pike Bay in Stagecoach Reservoir
- Morrison Bay in Stagecoach Reservoir
- Below the Stagecoach Reservoir dam
- Entrance of Service Creek into the Yampa River
- Yampa River directly above Lake Catamount
- Center of Lake Catamount
- Below Lake Catamount Dam
- Ski Pond (off-channel pond)
- Steamboat Springs
- Center of Elkhead Reservoir
- Below Elkhead Reservoir Dam

The water chemistry samples from the above waters were analyzed for 23 elements and two ratios:

Sodium (Na)	Magnesium (Mg)	Aluminum (Al)	Silicon (Si)
Sulfur (S)	Calcium (Ca)	Potassium (K)	Lithium (Li)
Cerium (Ce)	Rhenium (Re)	Lead (Pb)	Uranium (U)
Vanadium (V)	Chromium (Cr)	Iron (Fe)	Cobalt (Co)
Nickel (Ni)	Zinc (Zn)	Rubidium (Rb)	Strontium (Sr)
Molybedenum (Mo)	Barium (Ba)	Arsenic (As)	

Mole ratio of SR87/86
Ratio of CA/Sr

The preliminary results (Task 1) show that there appears to be sufficient variation across the matrix of these elements and ratios among the waters named above to develop a distinct chemical fingerprint for each water from a combination of these chemical attributes. These fingerprints subsequently should be detectable in the otolith bones of northern pike inhabiting these waters and enable a chronological map of water of origin (spawning/nursery site) and subsequent movement of the fish to and residence in other waters.

VII. Task Description and Schedule

1. Pilot study completed spring 2005 to determine differences in water chemistry
2. Young-of-year pike collection will begin May 2005
3. Sentinel cage experiment will begin June 2005
4. Quarterly adult fish collection will begin spring 2005
5. Laboratory work finished by December 2005
6. Written report of results finished by May 2006

VIII. FY-2005 Work

- Deliverables/Due Dates
    - Tasks 2-4: annual progress report – November 15, 2005

- Budget

- Labor			
Graduate student salary @ $1400/mo., benefits, tuition		$ 21,655	
Technician (hourly @ $ 10/hr), plus benefits			5,425
	Total		$ 27,080
- Travel			$ 2,000
- Equipment			$ 0
- Supplies – nets, microscope slides, etc.		$ 1,000	
- Contract services - open purchase order for microchemistry laboratory analyses			$ 6,000
- Total			$ 36,080[1]

[1] $10,000 of this total requested from Recovery Program; $26,080 paid by CDOW

FY-2006 Work (for multi-year study)

- Deliverables/Due Dates
    - Tasks 2-6: Final report – May 31, 2006
- Budget estimate: same break out as FY 2005

IX. Budget Summary *[Provide total AND break-out by funding target (e.g. station)]**

FY-2005 $36,080 Cost share: $10,000 CRRP; $26,080 CDOW
FY-2006 $36,080 Cost share: $10,000 CRRP; $26,080 CDOW

Total: CRRP - $20,000; CDOW - $52,160

X. Reviewers *[For new projects or ongoing-revised projects, list name, affiliation, phone, and address of people who have reviewed this proposal.]*

XI. References

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Study Area

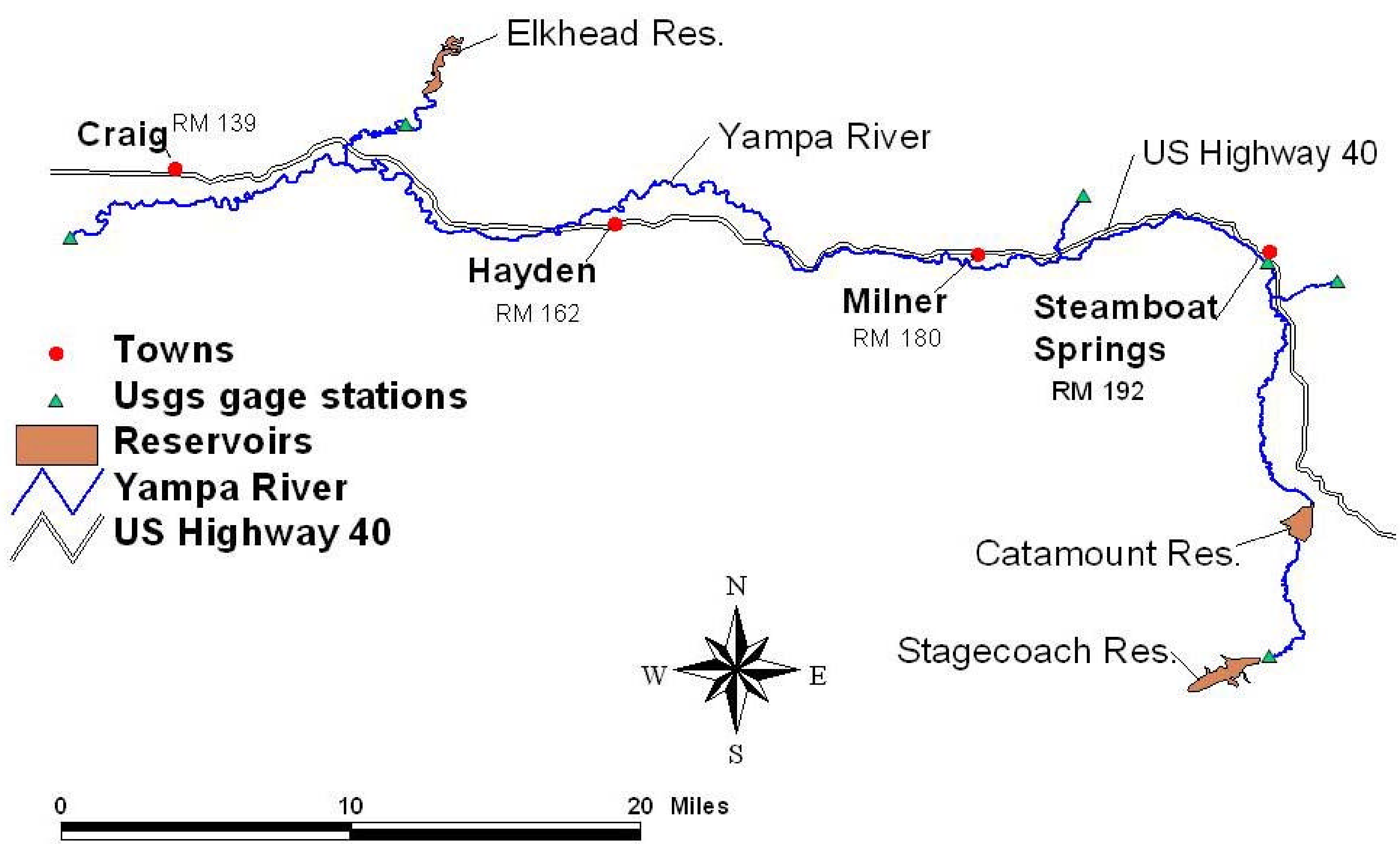

Figure 1. Map displaying the Yampa River in northwest Colorado. This project will focus on the river section from Stagecoach Reservoir until Steamboat Springs (Hill 2004).